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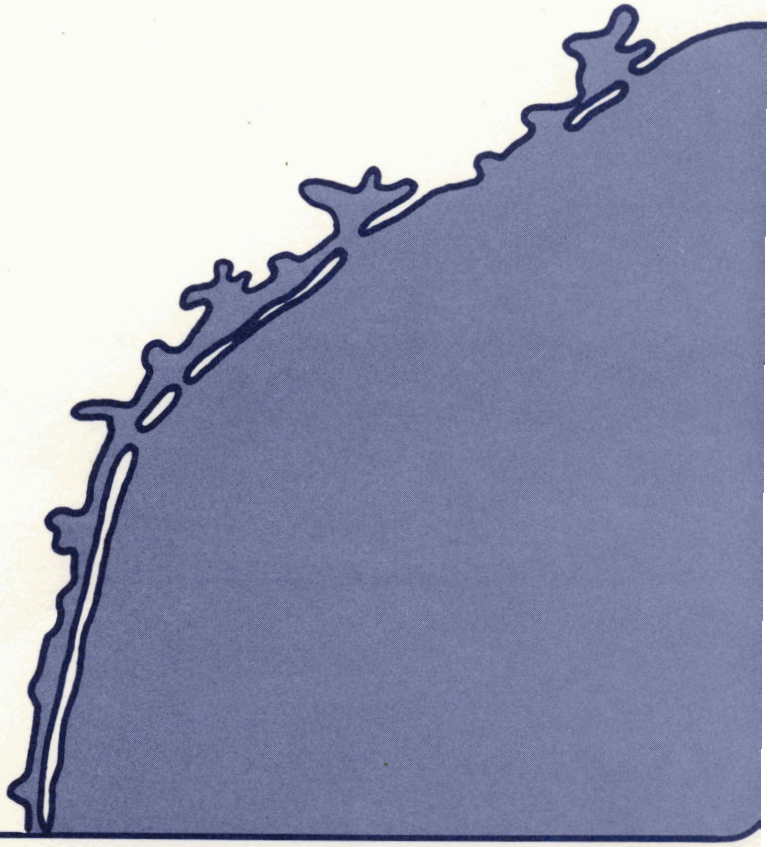
Ports on the Texas Gulf Coast - - Economic Importance and Role for Texas and U.S. Grain Crops



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Ports on the Texas Gulf Coast--
Economic Importance and Role for Texas and U.S. Grain Crops

Edward Mitch Johnson and Stephen Fuller

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Department of Agricultural Economics

The Texas Agricultural Experiment Station

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Ports on the Texas Gulf Coast--Economic Importance and Role for Texas and U.S. Grain Crops

Edward Mitch Johnson and Stephen Fuller[1]

U.S. agricultural exports are of increasing importance to the farm sector and to the Nation's economic well-being. Approximately 25 percent of the U.S. farm sector's revenue comes from agricultural exports and 65 to 75 percent of this revenue is generated from the foreign sales of grain and soybeans. Foreign consumers are purchasing increasing portions of the U.S. agricultural output, particularly from grain and soybean production (Table 1). In recent years, over 50 percent of the U.S. annual wheat and soybean production and 25 to 30 percent of the corn and grain sorghum production have been destined for foreign markets [3]. In addition, agricultural exports play a significant role in attempting to offset a widening trade deficit which is largely caused by a growing dependence on foreign energy sources and increasing energy prices.

Grain is transported from the inland production areas of the United States through a domestic transportation network of truck, rail and barge to port areas. These flows connect with the international maritime system via the port elevator, the nexus between these two transportation systems. The port elevator is the vital link between these two essential systems of transport and must orchestrate each system to achieve maximum efficiency [2].

For the U.S. transportation system to adequately meet expanding export demand, several key issues must be addressed. These issues include rail car availability, multiple-car and unit train rates and services, rail branchline abandonments, motor and railroad carrier deregulation, and agricultural exemp-

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1 Respectively, research assistant and associate professor (Department of Agricultural Economics), the Texas Agricultural Experiment Station.

Table 1. Total United States Exports of Grain Sorghum, Wheat, Corn and Soybeans, 1970-1978[1]

(000 bushels)

Year	Grain Sorghum	Wheat	Corn	Soybeans
1970	143,249	641,714	538,019	433,153
1971	114,508	600,022	503,402	428,845
1972	146,307	783,693	858,837	440,136
1973	217,549	1,377,432	1,269,694	478,551
1974	214,561	925,160	1,152,580	504,905
1975	229,635	1,142,541	1,292,252	456,342
1976	230,408	969,363	1,733,519	560,953
1977	227,008	891,404	1,576,824	592,839
1978	190,058	1,245,762	1,955,788	770,040

[1] USDA (Agricultural Marketing Service), Grain Market News, Government Printing Office, Volumes 18-26, 1970-1978.

tions and backhaul limitations associated with the trucking industry. In dealing with the aforementioned problems and issues, public and private policy decision-makers require information. When researchers and decision-makers attempt to solve transportation problems with limited information, their task is difficult or perhaps impossible. The purpose of this report is to provide a portion of the background information necessary for sound transportation policy decisions.

OBJECTIVES OF STUDY

The specific objectives of this study were to:

1) describe the importance of Gulf Coast ports to U.S. grain (wheat, corn, grain sorghum) and soybean exports, with special emphasis on Texas Gulf ports;
2) describe the market area for the Texas Gulf grain ports; and
3) describe the temporal and spatial grain and soybean flow patterns to Texas Gulf ports for the calendar year 1977.

This report provides insight into the Texas Gulf grain ports, their market areas, and the associated export grain transportation system. Information contained in this study will be used in a national grain-flow study presently being constructed by land grant colleges of all major grain and soybean producing states in the United States.[2] The overall objective of the national study, like this study, is to provide researchers and decision-makers with some of the information needed to evaluate and solve transportation problems.

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2 This is an activity of North Central Regional Technical Committee 137. This project is entitled, "Evaluation of Alternative Rural Freight Transportation, Storage and Distribution Systems."

METHODOLOGY

The primary data on grain and soybean flows to Texas Gulf ports were obtained by interviews with port elevator management and the elevators' unloading records. All gathered primary data pertained to the 1977 calendar year. Information on the grains' geographic origin, time of arrival at the port elevator, and utilized transportation mode was determined from the port elevator weighmaster's record. Receipts were classified according to the originating state. Receipts originating within Texas were traced to one of seven Texas regions. Each region consisted of one or more crop-reporting districts. The names of the seven regions and their associated crop-reporting districts are as follows (Figure 1): Northern High Plains--Crop-Reporting District 1-N; Southern High Plains--Crop-Reporting District 1-S; Rolling Plains--Crop-Reporting Districts 2-N, 2-S, and 3; East Texas--Crop-Reporting Districts 4, 5-N, and 5-S; Gulf Coast--Crop-Reporting Districts 8-N, 8-S, and 9; Rio Grande Plains--Crop-Reporting Districts 10-N and 10-S; and Pecos Plateau--Crop-Reporting Districts 6 and 7.

TEXAS GULF GRAIN PORTS

Gulf grain ports are geographically identified as belonging to one of four port areas--these are the East Gulf ports, Mississippi River ports, North Texas Gulf ports, and South Texas Gulf ports.[3] The East Gulf ports include facilities at Mobile, Alabama, and Pascagoula, Mississippi; Mississippi River ports include those export elevators located on the Mississippi River between New Orleans and Baton Rouge, Louisiana; North Texas Gulf ports include grain facilities at Beaumont, Port Arthur, Houston, and Galveston, Texas;

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3 This regional demarcation of port areas is analogous to that of the USDA's Grain Market News.

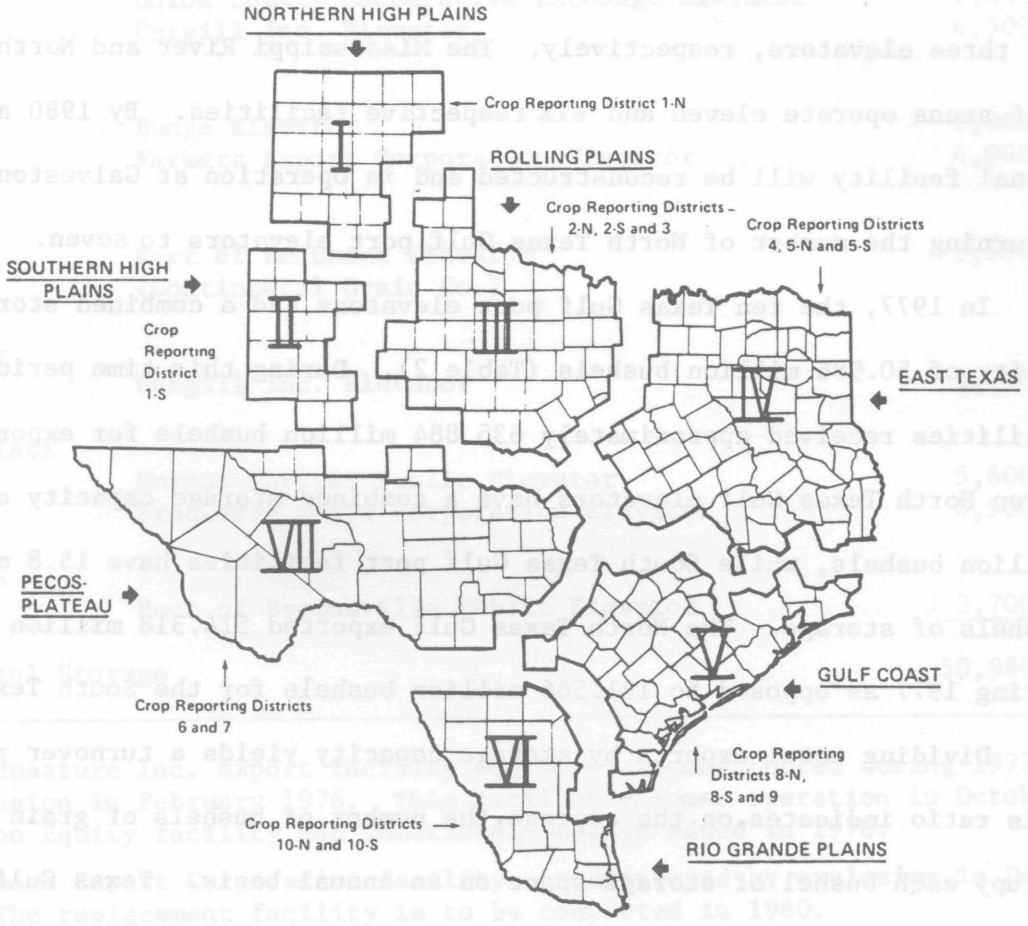

Figure 1. Seven Texas Study Regions

and South Texas Gulf ports include export facilities at Corpus Christi and Brownsville.

Currently, twenty-three export elevators operate on the Gulf; these facilities represent approximately one-third of the U.S. operating export elevators [1]. The East Gulf and South Texas Gulf port areas operate two and three elevators, respectively. The Mississippi River and North Texas Gulf areas operate eleven and six respective facilities. By 1980 an additional facility will be reconstructed and in operation at Galveston, thus returning the number of North Texas Gulf port elevators to seven.

In 1977, the ten Texas Gulf port elevators had a combined storage capacity of 50.986 million bushels (Table 2). During this time period, these facilities received approximately 635.884 million bushels for export. The seven North Texas Gulf elevators have a combined storage capacity of 35.186 million bushels, while South Texas Gulf port facilities have 15.8 million bushels of storage. The North Texas Gulf exported 514.318 million bushels during 1977 as opposed to 121.566 million bushels for the South Texas Gulf.

Dividing total exports by storage capacity yields a turnover ratio. This ratio indicates, on the average, the number of bushels of grain which occupy each bushel of storage space on an annual basis. Texas Gulf ports had an overall turnover ratio of 12.47 in 1977. The South Texas and North Texas Gulf port areas had turnover ratios of 7.69 and 14.62, respectively. A larger turnover ratio implies a fuller utilization of capacity and a critical need to coordinate the land-based transportation modes with the ocean-going grain ships.

Table 3 shows the estimated turnover ratios for the North and South Texas Gulf for the years 1972-1978. The North Texas Gulf had its highest

Table 2. Texas Gulf Port Area Elevators with Associated Storage Capacity, 1977

Port	Elevator	Storage Capacity (000 bu.)
Houston[1]		
	Port of Houston Public Elevator	6,000
	Union Equity Cooperative Exchange Elevator	6,400
	Cargill Inc. Elevator	4,500
Galveston[2]		
	Bunge Elevator	7,000
	Farmers Export Corporation Elevator	4,000
Beaumont		
	Port of Beaumont Elevator (Continental Grain Co.)	3,586
Port Arthur		
	Cargill Inc. Elevator	3,700
Corpus Christi		
	Corpus Christi Public Elevator	5,600
	Producers Grain Corporation Elevator	6,500
Brownsville		
	Port of Brownsville Public Elevator	3,700
Total Storage		50,986

1 The Goodpasture Inc. export facility was being reconstructed during 1977 due to an explosion in February 1976. This facility resumed operation in October 1978. The Union Equity facility had additional storage added in 1978.

2 The Farmers Export Corporation facility was destroyed by explosion in December 1977. The replacement facility is to be completed in 1980.

Table 3. Texas Gulf Port Estimated Turnover Ratios, 1972-1978[1]

Year	Texas Gulf	North Texas Gulf	South Texas Gulf
1972	8.15	9.01	5.79
1973	16.17	17.67	12.05
1974	11.29	12.14	8.97
1975	12.84	13.46	11.15
1976	13.15	15.11	8.80
1977	12.47	14.62	7.69
1978	15.47	17.73	10.50
Average (1972-1978)	12.73	14.11	9.28

[1]Calculated by dividing annual exports by annual storage capacity. Export volumes from USDA (Agricultural Marketing Service), Grain Market News, Government Printing Office, volumes 20-26, 1972-1978.

turnover ratios in 1973 and 1978, with respective ratios of 17.67 and 17.73. The South Texas Gulf had its highest turnover ratio in 1973 with a ratio of 12.05. On the average, for the period 1972-1978, the North Texas Gulf had a turnover ratio of 14.11 as opposed to the South Texas Gulf with a turnover ratio of 9.28. Table 3 shows that, in general, the North and South Texas Gulf turnover ratios move together; however, in all years the North Texas Gulf has a substantially higher ratio. The lower ratio at South Texas ports is partially attributable to the Port of Brownsville which does not share in equalized rail rates as do most other Gulf ports. Accordingly, this facility's export volume and market area are necessarily restricted.[4]

ROLE OF TEXAS GRAIN PORTS

Importance of Gulf Ports as U.S. Grain Outlet

Historically, Gulf ports have been responsible for approximately two-thirds of the U.S. total grain (wheat, corn, sorghum) and soybean exports (Table 4). During the 1970-1978 period, Texas Gulf ports exported nearly 23 percent of the U.S. total grain (wheat, corn, sorghum) and soybean outflow. North Texas Gulf ports' export share averaged approximately 18 percent of total U.S. outflow while the South Texas Gulf ports' share averaged about 4.5 percent of total exports (Table 4).

During 1970-1978 Gulf ports were responsible for 96.1, 54.0, 66.7, and 75.3 percent of the U.S. respective exports of sorghum, wheat, corn, and soybeans (Table 5). During this nine-year period, the portion of any particular commodity

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4 Most rail shipped grain received from Midwest origins moves on a Gulf equalized rate, i.e., the rate from the origin to all port areas is the same. The exception is Brownsville which does not share in these lower rates; accordingly, a restriction in volume and a lower turnover ratio exist.

Table 4. Estimated Percent of U.S. Sorghum, Wheat, Corn, and Soybean Exports Exiting North Texas, South Texas, and All Gulf Ports, 1970-78[1]

Year	% Exported North Texas Gulf	% Exported South Texas Gulf	% Exported All Gulf
1970	19.6	4.6	65.2
1971	23.0	3.9	67.4
1972	17.5	4.1	65.0
1973	22.9	5.7	67.2
1974	18.8	5.1	67.4
1975	18.7	5.6	65.4
1976	15.1	4.0	66.6
1977	15.6	3.7	67.6
1978	14.8	4.0	62.9
Average	18.0	4.5	66.0

1 Calculated from data taken from USDA's Grain Market News, Agricultural Marketing Services, Government Printing Office, volumes 18-26, 1970-1978.

Table 5. Percent of U.S. Sorghum, Wheat, Corn, and Soybean Exports Exiting North Texas Gulf Ports, South Texas Gulf Ports, and All Gulf Ports, 1970-78[1]

	Sorghum	Wheat	Corn	Soybeans
	Average, 1970-1978			
Percent from North Texas Gulf Ports	44.7	36.4	4.5	4.6
Percent from South Texas Gulf Ports	49.0	3.4	0.1	a
Percent from all Gulf Ports	96.1	54.0	66.7	75.3

[1]Calculated from data taken from USDA's Grain Market News, Agricultural Marketing Service, Government Printing Office, volumes 18-26, 1970-1978.

[a]Less than .05 percent.

exported via the Gulf remained relatively stable (Figures 2, 3, 4, 5). The percent of total U.S. sorghum exports exiting through Gulf ports ranged from a low of 90.5 percent in 1978 to a high of 99.9 percent in 1975. The portion of wheat exported through the Gulf ranged from 50.2 percent in 1978 to 62.5 percent in 1971. For the 1970-1978 period, the percent of U.S. corn exports through the Gulf ranged from 62.8 percent in 1978 to 69 percent in 1974. Portion of total soybean exports exiting via the Gulf ranged from 70.0 percent in 1972 to 79.1 percent in 1974.

Texas Export Share by Commodity

Figure 2 reveals Texas Gulf ports to be important exporters of sorghum. For the period 1970-1978, North Texas Gulf ports exported an average of 44.7 percent of total U.S. sorghum exports, while South Texas Gulf ports exported an average of 49 percent of the U.S. total sorghum outflow. Thus, during the 1970-1978 period, 93.7 percent of the U.S. foreign sorghum sales exited via Texas ports.

Texas Gulf ports are also important exporters of wheat (Figure 3). For the period 1970-1978, Texas Gulf ports exported an average of 39.8 percent of total U.S wheat outflow. North Texas Gulf ports exported 36.4 percent of total U.S. wheat exports while South Texas Gulf ports were responsible for 3.4 percent of the total outflow. It follows that South Texas Gulf ports are more important for sorghum exports than they are for wheat exports, while North Texas Gulf ports are significant outlets for the Nation's sorghum and wheat exports.

Figures 4 and 5 show Gulf ports to be important foreign outlets for corn and soybeans but Texas Gulf ports to be a relatively insignificant export area for these commodities. For the 1970-1978 time period, Texas Gulf ports handled an average of 4.6 percent of the respective corn and soybean outflow.

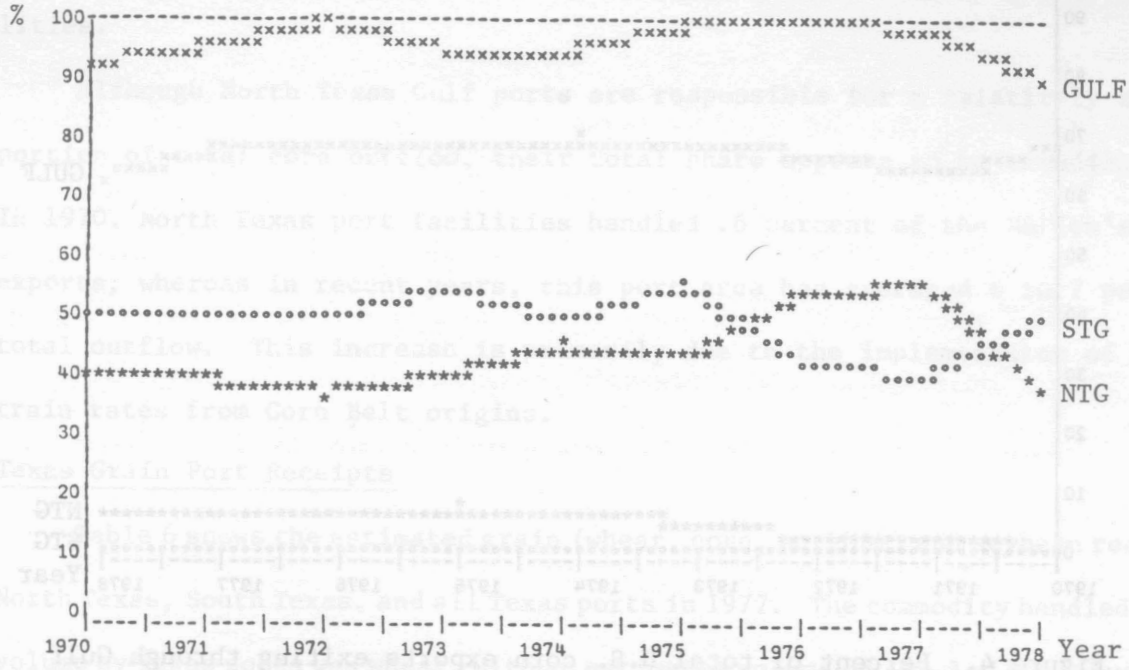

Figure 2. Percent of total U.S. sorghum exports exiting through Gulf Ports (GULF), North Texas Gulf Ports (NTG), and South Texas Gulf Ports (STG).

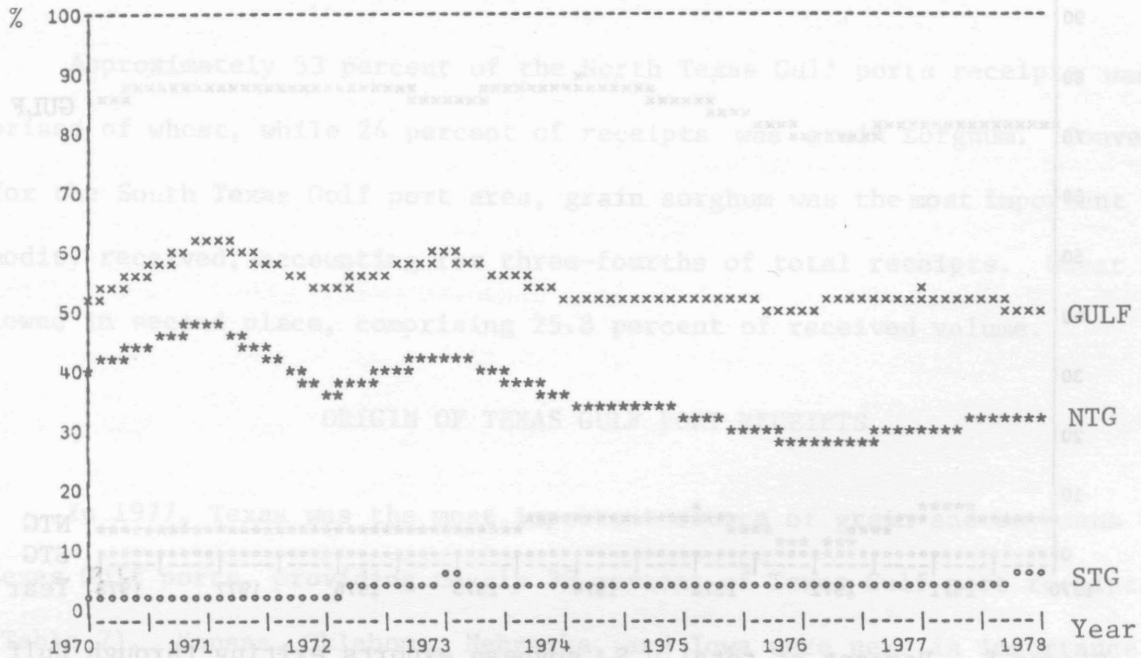

Figure 3. Percent of total U.S. wheat exports exiting through Gulf Ports (GULF), North Texas Gulf Ports (NTG), and South Texas Gulf Ports (STG).

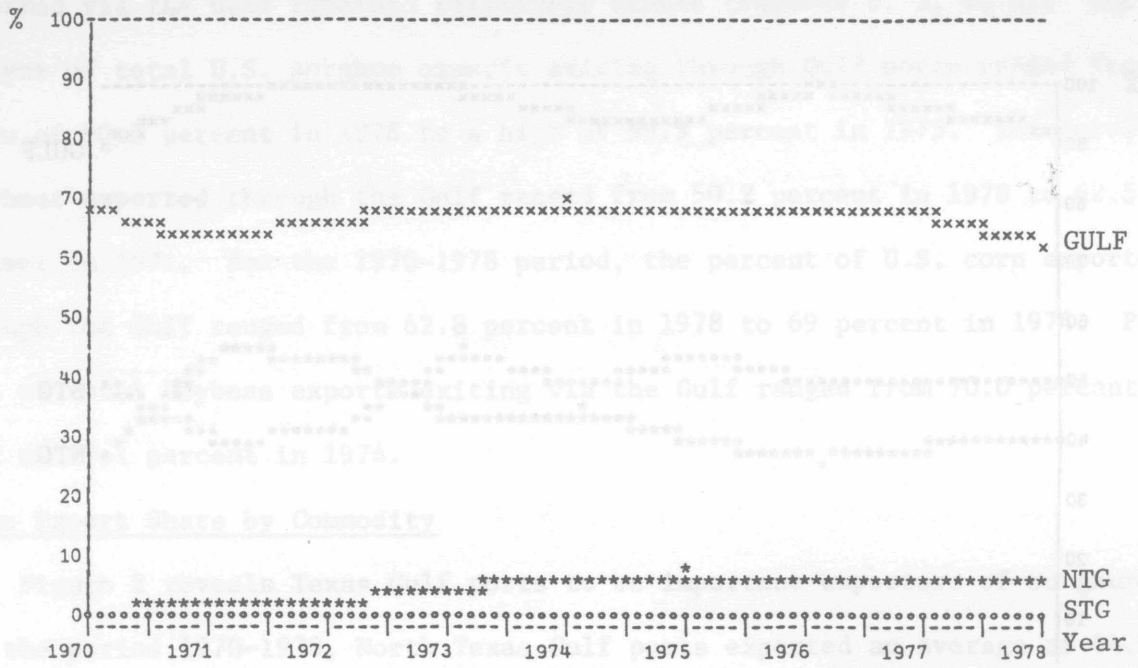

Figure 4. Percent of total U.S. corn exports exiting through Gulf Ports (GULF), North Texas Gulf Ports (NTG), and South Texas Gulf Ports (STG)

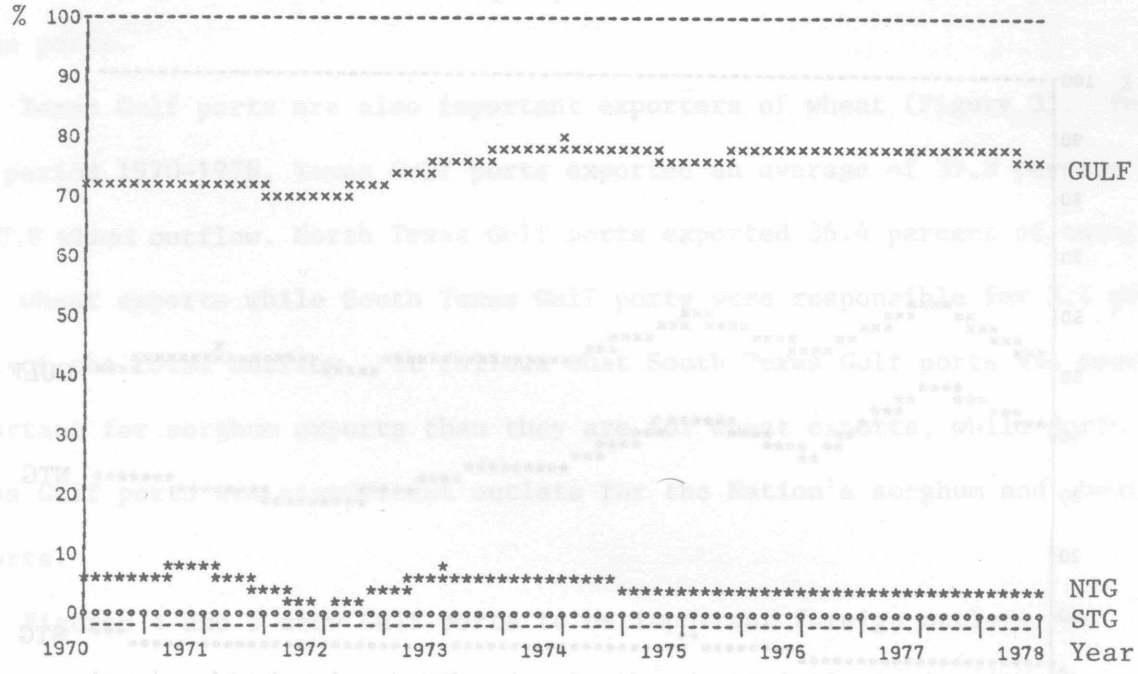

Figure 5. Percent of total U.S. soybean exports exiting through Gulf Ports (GULF), North Texas Gulf Ports (NTG), and South Texas Gulf Ports (STG).

Nearly all of these commodities were exported via the North Texas Gulf facilities.

Although North Texas Gulf ports are responsible for a relatively small portion of total corn outflow, their total share appears to be trending upward. In 1970, North Texas port facilities handled .6 percent of the Nation's corn exports, whereas in recent years, this port area has averaged 6 to 7 percent of total outflow. This increase is primarily due to the implementaton of unit train rates from Corn Belt origins.

Texas Grain Port Receipts

Table 6 shows the estimated grain (wheat, corn, sorghum) and soybean receipts at North Texas, South Texas, and all Texas ports in 1977. The commodity handled in greatest volume by Texas ports was wheat, with an estimated volume of 316.3 million bushels. Wheat, sorghum, corn, and soybeans accounted for 48.0, 33.7, 14.1 and 4.2 percent, respectively, of the total grain and soybean receipts of Texas Gulf ports in 1977.

Approximately 53 percent of the North Texas Gulf ports receipts was comprised of wheat, while 24 percent of receipts was grain sorghum. Conversely, for the South Texas Gulf port area, grain sorghum was the most important commodity received, accounting for three-fourths of total receipts. Wheat followed in second place, comprising 25.8 percent of received volume.

ORIGIN OF TEXAS GULF PORT RECEIPTS

In 1977, Texas was the most important source of grain and soybeans to Texas Gulf ports, providing nearly 30 percent of Texas Gulf port receipts (Table 7). Kansas, Oklahoma, Nebraska, and Iowa were next in importance, providing 23.9, 14.8, 14.1, and 10.3 percent of total Texas Gulf receipts, respectively. The most important sorghum originator was Texas (49%),

Table 6. Estimated Grain and Soybean Receipts at North Texas, South Texas and All Texas Ports, 1977[1]

Commodity	North Texas Gulf Ports Bushels (000)	South Texas Gulf Ports Bushels (000)	All Texas Gulf Ports Bushels (000)
Grain Sorghum	128,769	93,205	221,974
Wheat	283,945	32,389	316,334
Corn	92,492	125	92,617
Soybeans	27,925	0	27,925
Total	533,131	125,719	658,850

1 Data obtained from export elevators. Data represents receipts during 1977 calendar year.

Table 7. Estimated Percent of Texas Gulf Port Grain and Soybean Receipts (Bushels) from Various Origins, 1977[1]

Region	Sorghum	Wheat	Corn	Soybeans	Total
	%	%	%	%	%
Texas	48.6	23.4	3.7	33.6	29.6
Northern High Plains	4.2	4.3	2.1	9.1	4.2
Southern High Plains	2.4	1.5	0.2	2.2	1.6
Rolling Plains	0.7	3.3	0.0	0.3	1.8
East Texas	15.1	14.1	0.0	a	11.9
Gulf Coast	21.0	0.2	1.4	22.0	8.3
Rio Grande Plains	5.2	0.0	0.0	0.0	1.8
Pecos-Plateau	a	a	0.0	0.0	a
Kansas	16.9	36.5	4.4	0.9	23.9
Oklahoma	1.4	29.9	0.1	0.0	14.8
Nebraska	25.8	5.4	19.8	2.3	14.1
Missouri	5.4	4.4	2.2	4.4	4.4
Colorado	0.0	0.3	0.0	0.0	0.1
New Mexico	0.1	0.1	0.0	0.0	0.1
Iowa	0.5	0.0	65.2	21.9	10.3
Louisiana	0.0	0.0	0.0	33.8	1.4
Illinois	0.9	0.0	2.1	1.2	0.6
Other States	0.4	0.0	2.5	1.9	0.7
Total All States	100.0	100.0	100.0	100.0	100.0

1 Calculated from data obtained from export elevators.

a Less than .05 percent.

while Kansas was the leading originator of wheat (37%) and Iowa the leading source of corn (65%). Texas and Louisiana each supplied about one-third of the Texas Gulf ports' soybean receipts. Figure 6 identifies those states served by Texas Gulf port grain elevators.

Table 7 indicates percent of total receipts originating from each of the seven Texas subregions. Approximately 40 percent of the ports' sorghum receipts originated in the Gulf Coast, East Texas, and Rio Grande Plains regions of Texas. The Gulf Coast area originated about 22 percent of the Texas ports' soybean inflow, while about 14 percent of the wheat receipts originated from East Texas origins. A substantial portion of the wheat from East Texas originated with inland terminals at Ft. Worth, Texas. Much of the wheat transiting at Ft. Worth actually originates from Kansas, Oklahoma, and other Texas areas. It follows that the grain indicated to have been originated in the East Texas area may not have been produced there. Tables 8 and 9 identify portions of respective receipts at North and South Texas Gulf ports which originate from various states and subregions of Texas.

In 1977, North Texas Gulf ports received 25.5 percent and 21.8 percent of their respective receipts from Kansas and Texas origins. Other areas supplying grain in significant quantities were Oklahoma (18%), Nebraska (14%), and Iowa (13%). Texas and Nebraska supplied 38.3 and 31.7 percent of the respective sorghum inflow, while Kansas and Oklahoma, respectively, originated 37.5 and 32.6 percent of the North Texas ports' wheat receipts. Iowa supplied two-thirds of the corn while Texas and Louisiana each originated about one-third of the port areas' soybean receipts. The East Texas and Gulf Coast regions supplied significant quantities of sorghum (30%), wheat (12%), and soybeans (22%) to the North Texas Gulf port area (Table 8).

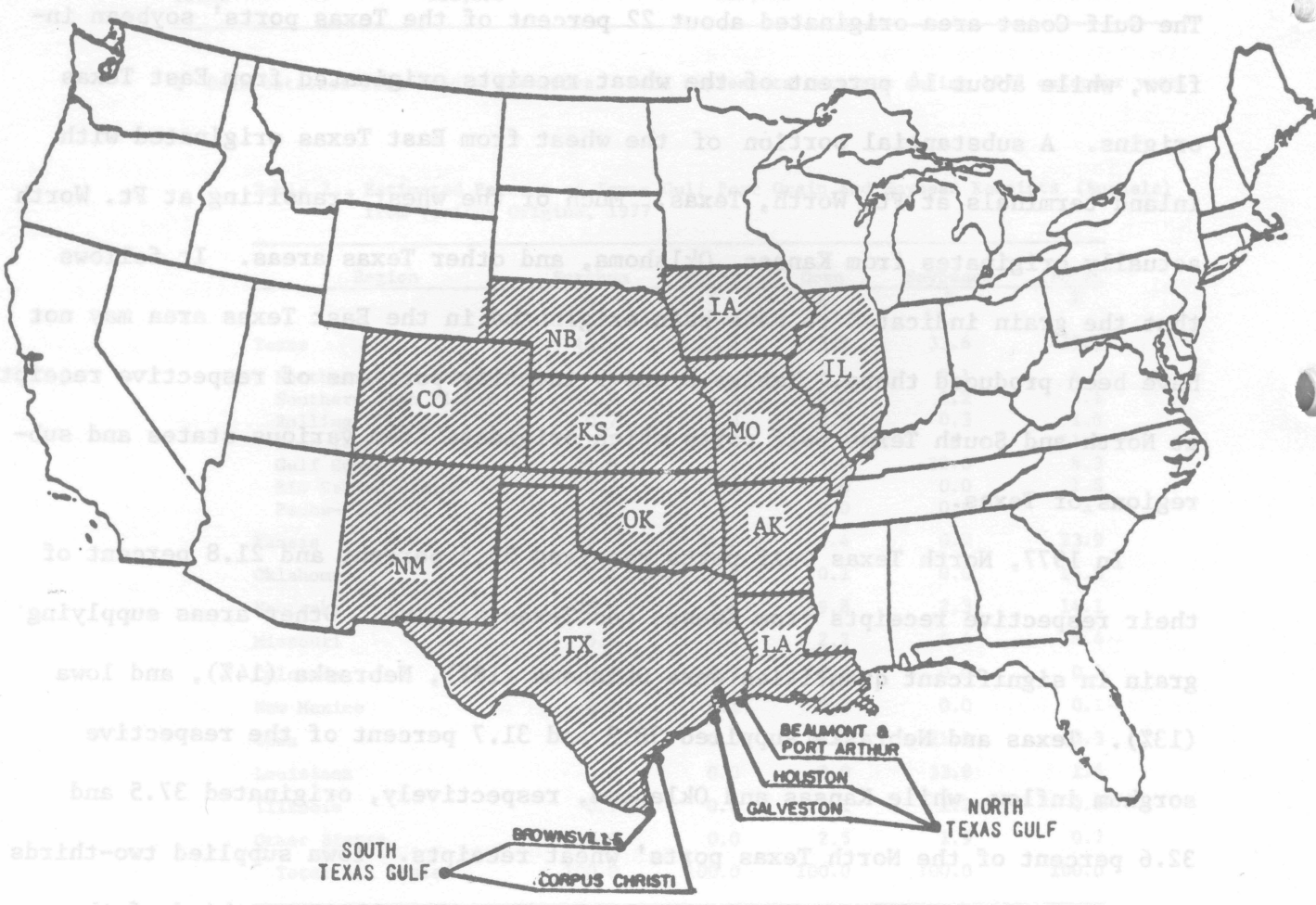

Figure 6. Texas Gulf Ports and Market Area

Table 8. Estimated Percent of North Texas Gulf Port Grain and Soybean Receipts (Bushels) from Various Origins, 1977[1]

Region	Sorghum	Wheat	Corn	Soybeans	Total
	%	%	%	%	%
Texas	38.3	19.1	3.6	33.6	21.8
Northern High Plains	3.2	3.1	2.1	9.0	3.3
Southern High Plains	3.5	1.0	0.2	2.2	1.5
Rolling Plains	1.1	2.6	0.0	0.3	1.7
East Texas	20.4	12.3	0.0	0.0	11.5
Gulf Coast	10.1	0.1	1.3	22.1	3.8
Kansas	19.3	37.5	4.4	0.9	25.5
Nebraska	31.7	5.7	19.8	2.3	14.2
Oklahoma	2.1	32.6	0.1	0.0	17.9
Missouri	6.0	4.8	2.2	4.4	4.6
Iowa	0.8	0.0	65.3	21.9	12.7
Louisiana	0.0	0.0	0.0	33.8	1.8
Illinois	1.2	0.0	2.1	1.2	0.7
Colorado	0.0	0.3	0.0	0.0	0.1
Other States	0.6	0.0	2.5	1.9	0.7
Total All States	100.0	100.0	100.0	100.0	100.0

1 Calculated from data obtained from export elevators.

Table 9. Estimated Percent of South Texas Gulf Port Grain Receipts (Bushels) from Various Origins, 1977[1]

Region	Sorghum	Wheat	Corn	Total
	%	%	%	%
Texas	62.8	60.9	100.0	62.5
Northern High Plains	5.5	15.5	0.0	8.1
Southern High Plains	0.9	5.5	0.0	2.1
Rolling Plains	0.0	9.1	0.0	2.4
East Texas	7.9	29.6	0.0	13.5
Gulf Coast	36.0	1.0	100.0	27.1
Rio Grande Plains	12.4	0.0	0.0	9.2
Pecos-Plateau	0.1	0.2	0.0	0.1
Kansas	13.7	28.3	0.0	17.4
Oklahoma	0.3	5.3	0.0	1.6
Nebraska	17.8	2.7	0.0	13.9
Missouri	4.7	1.4	0.0	3.8
Colorado	0.0	0.4	0.0	0.1
New Mexico	0.1	1.0	0.0	0.3
Other States	0.6	0.0	0.0	0.4
Total All States	100.0	100.0	100.0	100.0

1 Calculated from data obtained from export elevators.

Texas was the principle source of grain received at South Texas ports in 1977; nearly two-thirds of this port area's receipts came from Texas origins. Kansas and Nebraska, respectively, supplied 17.4 and 13.9 percent of this port area's grain receipts in 1977. The Gulf Coast area supplied 27.1 percent of the South Texas Gulf ports' grain receipts. This exceeded the amounts sent by either Kansas or Nebraska. Texas was the leading supplier of wheat (63%), sorghum (61%), and corn (100%). It follows that South Texas ports serve primarily Texas origins, while North Texas ports represent a major export outlet for the Central and Southcentral states (Tables 8 and 9).

PORTION OF STATES PRODUCTION MARKETED THROUGH TEXAS GULF PORTS

To gain insight into the importance of Texas Gulf ports as a market outlet for a particular state's grain and soybean production, the volume of grain or soybeans received at the port from a particular state was divided by that state's production. This yielded a parameter which indicated the approximate portion of a state's production destined for Texas Gulf ports. Table 10 shows export shipments to the Texas Gulf as a percent of each state's total production for the 1977 calendar year.[5]

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5 To make these calculations, it was assumed that grain originating from inland terminals located in a particular state was produced within that state. It was necessary to make this assumption because the port data did not provide additional detail to do otherwise. Grain received at an inland terminal may have originated from outside its region. In which case, those regions which include inland terminals may be represented by parameters which are over-estimates of the portion of production going to export; whereas, regions that do not have inland terminals but ship to inland terminals may be represented by parameters which are under-estimates of the portion of production going to export.

Table 10. Estimated Texas Gulf Port Grain and Soybean Receipts from Various States Expressed as a Percent of Total Production in the Respective State, 1977[1]

	Grain Sorghum	Wheat	Corn	Soybeans	Total
	%	%	%	%	%
Texas	46.8	62.9	2.3	47.5	37.7
Kansas	15.5	33.6	2.5	0.9	20.3
Oklahoma	13.9	53.9	1.3	0.0	46.3
Nebraska	37.9	16.4	2.9	1.6	10.1
Missouri	19.7	23.0	1.0	0.9	6.2
Colorado	0.0	1.6	0.0	0.0	0.6
New Mexico	1.1	3.4	0.0	0.0	1.4
Iowa	50.2	0.0	5.5	2.5	5.0
Louisiana	0.0	0.0	0.0	15.0	13.9
Illinois	46.9	0.0	0.2	0.1	0.2
Other States	1.6	0.0	0.1	0.1	0.1
U.S. Total	28.1	15.6	1.5	1.6	6.0

1 Calculated by dividing receipts from a particular origin by that origin's 1977 production.
Estimated receipts derived from interview information. Production in Texas from: Texas Department of Agriculture, USDA, SRS, 1977 Texas Small Grain Statistics and 1977 Texas Field Crop Statistics. Production in various states from: USDA, SRS, Agricultural Statistics, 1978.

Based on the above procedure, it was found that significant portions of Texas (38%), Kansas (20%), Oklahoma (46%), Nebraska (10%), and Louisiana (14%) grain and soybean production were destined for Texas Gulf ports in 1977. During this calendar year, Texas Gulf ports provided an outlet for 6 percent of U.S. total production of sorghum, wheat,corn, and soybeans (Table 10).

As indicated in Table 10, a significant portion of the U.S. production of sorghum (28.1%) and wheat (15.6%) was marketed via Texas Gulf ports. In the same year, approximately 1.5 percent of the U.S. production of corn and soybeans was exported by the Texas port area.

The values in Table 10 indicate that nearly one-half of Texas' 1977 sorghum and soybean production and nearly two-thirds of the state's wheat production were marketed through Texas Gulf ports. Other states marketing a significant portion of a particular grain type via this outlet were Kansas, Oklahoma, Nebraska, and Missouri. For example, approximately one-third, one-half, and one-fourth of Kansas', Oklahoma's, and Missouri's respective 1977 wheat production flowed through Texas Gulf ports. Approximately 40 percent of Nebraska's sorghum was marketed from this port area.

TEMPORAL CHARACTERISTICS OF TEXAS GULF PORT RECEIPTS

In 1977, North Texas Gulf port receipts peaked in the December-March period and then declined to a low in May. The remaining months revealed a relatively even receipt pattern (Table 11).

Sorghum arrivals at North Texas ports were greatest in December-March and again in July. In the January-March period, 36.6 percent of all sorghum was received. This is in sharp contrast to the April-June quarter when 8.3 percent of all sorghum arrived. July and December accounted for 11.1 and 11.6 percent of total sorghum receipts, respectively. It is during July that much

Table 11. Estimated Percent of North Texas Gulf Port Grain and Soybean Receipts Per Month, 1977[1]

Month	Sorghum	Wheat	Corn	Soybeans	Total
January	11.9	8.5	16.1	13.2	10.9
February	13.4	6.9	20.5	10.2	11.0
March	11.3	8.4	23.1	7.8	11.6
April	2.9	8.7	9.2	3.9	7.1
May	3.0	5.0	5.5	5.7	4.7
June	2.4	11.3	2.6	.7	7.1
July	11.1	10.6	.1	.1	8.4
August	8.9	9.2	1.8	.1	7.4
September	8.9	8.8	3.8	3.9	7.7
October	5.1	6.8	4.9	26.9	7.1
November	9.5	6.5	5.7	19.3	7.7
December	11.6	9.3	6.7	8.3	9.3
Total	100.0	100.0	100.0	100.0	100.0

[1]Calculated from data obtained from export elevators.

of Texas' Coastal and Blacklands (East Texas) sorghum production is harvested and enters the export grain marketing channel. Other sorghum producing areas (Texas Plains, Nebraska, Kansas) harvest in the late fall months; much of this grain is marketed to North Texas ports in December through March.

Wheat receipts at the North Texas Gulf in 1977 displayed a more stable receipt pattern, with only a slight peak occurring during the harvest season of June and July. Per month wheat receipts were lowest in May; during which month only 5 percent of the annual wheat receipts arrived.

The temporal corn receipt pattern was less uniform than either the sorghum or wheat arrival patterns. During the first quarter of 1977, 59.7 percent of all corn receipts arrived at North Texas Gulf ports. Most of this corn originated from Iowa and Nebraska origins. Corn is harvested in this region in October through December; this accounts for the post-harvest receipt pattern. Monthly corn receipts steadily decreased after March, reaching a low of 0.1 percent in July. Throughout the remaining months, per month receipts steadily increased. Soybean receipts at the North Texas Gulf ports displayed peaks in the January-February period and the October-November period, with 23.4 and 46.2 percent of total receipts arriving in these periods, respectively. The January-February receipts tend to originate from Iowa origins and represent producers' post-harvest sales; the October-November receipts tend to originate from Texas-Louisiana origins. It is during this time period that much of Texas and Louisiana production is gathered.

Monthly receipt patterns displayed by the South Texas Gulf ports were similar to those displayed by North Texas Gulf ports (Table 12). January-March was a peak period, with an increase again occurring in July and December.

South Texas Gulf's sorghum receipts displayed a similar pattern to that found at North Texas Gulf ports; however, the South Texas Gulf displayed

Table 12. Estimated Percent of South Texas Gulf Port Grain Receipts Per Month, 1977[1]

Month	Sorghum	Wheat	Corn	Total
January	10.6	5.2	0.0	9.3
February	10.5	10.3	0.0	10.2
March	10.1	11.3	0.0	10.4
Arpil	8.4	9.5	0.0	8.7
May	6.0	12.0	0.0	7.6
June	8.6	5.8	0.0	7.9
July	15.5	5.0	0.0	12.8
August	4.4	8.0	32.0	5.3
September	3.5	6.8	67.2	4.4
October	4.9	7.8	0.8	5.7
November	6.5	6.0	0.0	6.4
December	11.0	12.3	0.0	11.3
Total	100.0	100.0	100.0	100.0

[1]Calculated from data obtained from export elevators.

less of a peak in the Janury-March period, and a greater peak in July than did the North Texas port area. South Texas ports receive a greater portion of their receipts from Texas origins that do North Texas ports; this accounts for the accentuated peak in July--the harvest period for much of Texas' production. Wheat receipts at the South Texas Gulf were relatively unifrom except for slight peaks in February-March, May, and December. Corn receipts for the South Texas Gulf were confined to the August-October period, with 99.2 percent of annual receipts arriving during August and September. South Texas ports receive all corn from Texas; in which case, their receipts are concentrated into the supplying regions post-harvest period (August-September).

TRANSPORTATION MODES UTILIZED IN GRAIN FLOWS TO TEXAS GULF GRAIN PORTS

Tables 13 and 14 show percent of grain and soybean receipts carried to the respective North and South Texas Gulf ports via the truck, rail, and barge modes.

In 1977, North Texas ports received 86.8, 12.6, and 1.6 percent of their grain and soybean receipts via rail, truck, and barge modes, respectively. Of all sorghum arriving in this port area, 76.9 percent was carried by rail, 21.5 percent by truck, and 1.6 percent by barge. It is estimated that 92.2 percent of all wheat receipts was rail delivered, while 7.4 and .4 percent of the respective wheat inflow were carried by the truck and barge modes. Ninety-eight percent of the corn received in this port area was rail carried, while the remaining 2 percent was truck delivered. Truck was the dominant mode involved in soybean carriage. Approximately 60 percent of the soybean receipts were delivered by truck, while the remaining 40 percent arrived by rail.

In general, the closer the grain or soybean origin to North Texas Gulf

Table 13. Estimated Modal Split on North Texas Gulf Port Grain and Soybean Receipts from Various Origins, 1977 [1]

Region	Sorghum			Wheat			Corn		Soybeans		Total		
	% Rail	% Truck	% Barge	% Rail	% Truck	% Barge	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck	% Barge
Texas	46.4	53.6	0.0	90.2	9.8	0.0	48.3	51.7	20.5	79.5	64.8	35.2	0.0
Northern High Plains	98.0	2.0	0.0	93.6	6.4	0.0	72.8	27.2	61.8	38.2	87.7	12.3	0.0
Southern High Plains	98.7	1.3	0.0	90.8	9.2	0.0	100.0	0.0	48.4	51.6	92.2	7.8	0.0
Rolling Plains	81.1	18.9	0.0	90.3	9.7	0.0	0.0	0.0	75.0	25.0	88.7	11.3	0.0
East Texas	45.5	54.5	0.0	89.7	10.3	0.0	0.0	0.0	0.0	100.0	70.8	29.2	0.0
Gulf Coast	9.5	90.5	0.0	0.0	100.0	0.0	0.0	100.0	0.0	100.0	6.0	94.0	0.0
Kansas	98.3	1.7	0.0	96.4	3.6	0.0	100.0	0.0	100.0	0.0	96.9	3.1	0.0
Nebraska	99.9	0.1	0.0	94.6	5.4	0.0	99.9	0.1	100.0	0.0	98.8	1.2	0.0
Oklahoma	70.5	29.5	0.0	88.1	11.9	0.0	94.8	5.2	0.0	0.0	87.6	12.4	0.0
Missouri	86.7	0.0	13.3	93.0	0.1	6.6	100.0	0.0	100.0	0.0	92.0	a	8.0
Iowa	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	0.0
Louisiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	99.9	0.1	99.9	0.0
Illinois	37.1	0.0	62.9	0.0	0.0	0.0	100.0	0.0	100.0	0.0	73.9	0.0	26.1
Colorado	0.0	0.0	0.0	90.4	9.6	0.0	0.0	0.0	0.0	0.0	90.4	9.6	0.0
Other States	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	0.0
Average All Receipts	76.9	21.5	1.6	92.2	7.4	0.4	98.1	1.9	39.5	60.5	86.8	12.6	0.6

1 Calculated from data obtained from export elevators.

a Less than .05 percent.

Table 14. Estimated Modal Split on South Texas Gulf Port Grain and Soybean Receipts from Various Origins, 1977 [1]

Region	Sorghum		Wheat		Corn		Total	
	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck
Texas	29.5	70.5	95.7	4.3	0.0	100.0	46.1	53.9
Northern High Plains	89.5	10.5	98.5	1.5	0.0	0.0	93.9	6.1
Southern High Plains	85.1	14.9	99.7	1.3	0.0	0.0	95.1	4.9
Rolling Plains	0.0	0.0	93.5	6.5	0.0	0.0	93.5	6.5
East Texas	94.0	6.0	97.8	2.2	0.0	0.0	96.2	3.8
Gulf Coast	14.1	85.9	0.0	100.0	0.0	100.0	13.9	86.1
Rio Grande Plains	2.4	97.6	0.0	0.0	0.0	0.0	2.4	97.6
Pecos-Plateau	0.0	100.0	0.0	100.0	0.0	0.0	0.0	100.0
Kansas	99.7	0.3	100.0	a	0.0	0.0	99.8	0.2
Oklahoma	100.0	0.0	98.8	1.2	0.0	0.0	99.9	0.1
Nebraska	100.0	0.0	99.5	0.5	0.0	0.0	100.0	a
Missouri	99.7	0.3	100.0	0.0	0.0	0.0	99.7	0.3
Colorado	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
New Mexico	100.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0
Other States	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
Average All Receipts	55.7	44.3	96.9	3.1	0.0	100.0	66.4	33.6

1 Calculated from data obtained from export elevators.

a Less than .05 percent.

ports, the greater the extent that truck are involved in carriage (Table 13). For example, 94 percent of the grain from Gulf Coast origins was truck transported, while only 2 to 3 percent of the grain from Kansas and Nebraska origins was truck carried. The only states originating barge shipments to North Texas Gulf ports were Missouri and Illinois.

South Texas grain ports receive a greater portion of their receipts by truck than does the North Texas port area (Table 14). Of all grain received by the South Texas Gulf ports, 66.4 percent was rail carried and 33.6 percent was truck carried. No grain was delivered by barge to this port area. Approximaltely 56 percent of the grain sorghum was delivered by rail while 44.3 percent was truck carried. Wheat flows to South Texas Gulf ports were primarily hauled by the rail mode. It is estimated that 96.9 percent of the wheat inflow was rail transported and 3.1 percent truck carried.

Distance from grain origin to the South Texas port area significantly affects the selected delivery mode. Grain originating from nearby locations is typically carried by truck whereas grain from more distant origins is generally rail transported (Table 14).

Portion of grain transported by each transportation mode is influenced by the month of the year in which the grain arrives (Table 15 and 16). For example, grain sorghum receipts at North Texas Gulf ports are predominantely rail carried until July and August, at which time truck deliveries increase measureably. The July and August receipts of grain sorghum originate in the Gulf Coast and East Texas regions. It is during this period that much of this area's grain sorghum is harvested and marketed.

In general, the portion of wheat receipts delivered by each mode was constant throughout the year. The percent of corn delivered by truck to the

Table 15. Estimated Monthly Modal Split on North Texas Gulf Port Grain and Soybean Receipts, 1977[1]

Month	Sorghum			Wheat			Corn		Soybeans		Total		
	% Rail	% Truck	% Barge	% Rail	% Truck	% Barge	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck	% Barge
January	75.6	23.8	0.6	94.2	5.8	0.0	99.4	0.6	42.5	57.5	87.3	12.5	0.2
February	83.6	16.4	0.0	91.3	8.7	0.0	99.0	1.0	65.7	34.3	90.3	9.7	0.0
March	90.2	9.8	0.0	91.0	8.6	0.4	99.6	0.4	84.9	15.1	93.7	6.3	0.0
April	76.2	22.3	1.5	90.9	9.0	0.1	100.0	a	90.7	9.3	91.5	8.3	0.2
May	82.2	17.1	0.7	90.7	9.3	0.0	100.0	a	99.6	0.4	91.8	8.1	0.1
June	78.7	17.6	3.7	89.2	10.2	0.6	99.8	0.2	58.3	41.7	88.9	10.3	0.8
July	24.1	75.9	0.0	94.3	5.4	0.3	84.4	15.6	13.6	86.4	71.7	28.1	0.2
August	63.8	32.3	3.9	91.1	8.1	0.8	39.3	60.7	0.0	100.0	80.9	17.5	1.6
September	86.8	10.0	3.2	94.0	5.5	0.5	93.6	6.4	20.0	80.0	90.0	8.8	1.2
October	83.7	8.2	8.1	93.7	6.0	0.3	99.2	0.8	18.0	82.0	77.6	20.8	1.6
November	90.7	6.5	2.8	92.3	7.1	0.6	99.7	0.3	19.4	80.6	83.3	15.7	1.0
December	95.1	4.6	0.3	94.0	5.8	0.2	99.6	0.4	19.8	80.2	91.6	8.2	0.2
Average All Receipts	76.9	21.5	1.6	92.2	7.4	0.4	98.1	1.9	39.5	60.5	86.8	12.6	0.6

1 Calculated from data obtained from export elevators.

a Less than .05 percent.

Table 16. Estimated Monthly Modal Split on South Texas Gulf Port Grain and Soybean Receipts, 1977[1]

Month	Sorghum		Wheat		Corn		Total	
	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck	% Rail	% Truck
January	55.5	44.5	99.6	0.4	0.0	0.0	61.9	38.1
February	58.5	41.5	99.9	0.1	0.0	0.0	70.5	29.5
March	68.7	31.3	99.9	0.1	0.0	0.0	77.4	22.6
April	74.6	25.4	99.5	0.5	0.0	0.0	81.6	18.4
May	62.9	37.1	94.7	5.3	0.0	0.0	75.9	24.1
June	55.2	44.8	67.3	32.7	0.0	0.0	57.5	42.5
July	16.5	83.5	98.0	2.0	0.0	0.0	24.8	75.2
August	35.7	64.3	97.9	2.1	0.0	100.0	59.4	40.6
September	79.6	20.4	98.1	1.9	0.0	100.0	85.8	14.2
October	92.1	7.9	99.1	0.9	0.0	100.0	94.6	5.4
November	76.4	23.6	99.8	0.2	0.0	0.0	82.1	17.9
December	50.0	50.0	99.8	0.2	0.0	0.0	63.9	36.1
Average All Receipts	55.7	44.3	96.9	3.1	0.0	100.0	66.4	33.6

1 Calculated from data obtained from export elevators.

North Texas port area increased significantly during July and August. It is during these months that Gulf Coast corn is harvested. The modal split on soybean receipts varies substantially throughout the year. In May, 1 percent of the soybean flow was truck delivered whereas in August, all receipts were hauled by trucks. In general, the rail mode is more important in those months when soybean flows originate from Iowa, Missouri, Nebraska, and Kansas sources, while the truck mode is more important when soybeans originate from Louisiana and Texas areas.

Table 16 shows the impact of month of grain receipt on modal split at South Texas ports. In general, the temporal impact on modal split for sorghum receipts at South Texas ports is similar to that observed at North Texas ports; however, the South Texas Gulf sorghum receipts display a more truck oriented modal split in all months. Wheat receipts at the South Texas Gulf were rail dominated except for the May-June harvest seasons.

SUMMARY

Texas Gulf grain ports are an important outlet for the U.S. grain and soybean exports. For the 1970-1978 period, this port area accounted for an average of nearly 94 and 40 percent of U.S. respective grain sorghum and wheat exports. During the same time period, Texas Gulf ports were responsible for nearly 5 percent of the corn exports and 5 percent of the soybean exports. Historically, Texas Gulf ports have been responsible for approximately 23 percent of the outflow of wheat, corn, grain sorghum, and soybeans, i.e., nearly one out of every four bushels of these commodities has been exported from the United States by way of Texas ports.

In 1977, Texas was the most important source of grain and soybeans to Texas Gulf ports, providing nearly 30 percent of total receipts. Kansas, Oklahoma, Nebraska, and Iowa were next in importance, providing approximately 24, 15, 14, and 10 percent of the respective Texas port elevator inflow. The most important sorghum originator was Texas (49%), while Kansas was the leading supplier of wheat (37%) and Iowa the leading corn source (65%). Texas and Louisiana each supplied about one-third of Texas ports' soybean receipts.

Analysis indicates that nearly one-half of Texas' 1977 sorghum and soybean production and nearly two-thirds of the States' wheat production were marketed through Texas Gulf ports. Other states marketing a significant portion of a particular grain type via this outlet were Kansas, Oklahoma, Nebraska, and Missouri. For example, approximately one-third, one-half, and one-fourth of Kansas', Oklahoma's, and Missouri's respective 1977 wheat production flowed through Texas ports, while approximately 40 percent of Nebraska's grain sorghum was marketed from this port area.

In 1977, North Texas ports (Houston, Galveston, Beaumont, Port Arthur) received 87, 12, and 1 percent of their grain and soybean receipts via rail, truck, and barge modes, respectively. South Texas grain ports (Corpus Christi, Brownsville) received a greater portion of their receipts by truck than did the North Texas port area. Of all grain received by the South Texas Gulf, 66 percent was rail carried and 34 percent was truck carried. No grain was delivered by barge to this port area.

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